REMARKS

Claims 1-8 were pending in the application. Claims 2, and 5-8 have been amended. Claim 2 was amended to clarify that the reflector is structured such that the vertical cross section and the horizontal cross section each substantially have a shape that is part of an oval. Claims 5-8 have been amended to remove the term "or/and." Claims 9-15 have been added. Support for the claim amendments and new claims can be found in the specification, *inter alia*, at page 7, lines 14-23, page 23, lines 4-16, Figs. 1 and 16A-16C, and the original claims. Accordingly, applicant respectfully submits that no new matter has been added. Upon entry of the foregoing amendments, claims 1-15 are now pending in the present application.

Applicant respectfully requests reconsideration of the present application in view of the foregoing amendments and in view of the reasons which follow.

Claim Rejections Under 35 U.S.C. § 112, second paragraph

In the Office Action, claims 5-8 were rejected under 35 U.S.C. § 112, second paragraph as being indefinite. Applicants amended claims 5-8 to remove the term "or/and," without narrowing the claim scope. Accordingly, applicant respectfully requests that the rejection be withdrawn.

Claim Rejections Under 35 U.S.C. § 103(a)

In the Office Action, claims 1-4 were rejected under 35 U.S.C. §103 as being unpatentable over Strobel et al. (USP 5,204,820) in view of Bertling et al. (USP 5,440,456). Claims 5-8 were rejected under 35 U.S.C. §103(a) as being unpatentable over Strobel et al. and Bertling et al. as applied to claim 1 above, and further in view of Kusagaya (US 2001/0043474). Applicant respectfully traverse these rejections for the following reasons.

Applicant agrees with the office action (at page 2) that Strobel does not teach or suggest the recited lens of applicant's claim 1. However, applicant respectfully submits that the invention as recited in claim 1 is patentable over the references of record

because even if Strobel and Bertling could be combined in the manner proposed in the office action, the combination would not result in applicant's claimed invention.

Strobel is directed to a projector type headlamp, in which a reflector 1, having an asymmetrically optically effective surface is combined with a lens 2, which has a focal point, is an aspherical lens, and is designed according to the formula described at Strobel, col. 3, lines 1-47. In Strobel, the reflector 1 is designed to be adapted to lens 2. See e.g., Strobel, col. 6, lines 62-66. According to the office action, at page 2, in order to produce applicant's claimed invention, one of ordinary skill in the art would have been motivated to replace Strobel's lens 2 with lens 24 of Bertling. However, this combination of Strobel's reflector 1 and Bertling's lens 28 would not operate in the manner claimed "so as to be irradiated to an external section in accordance with a target light distribution pattern." (see claim 1). In contrast, the combination of Strobel's reflector and Bertling's lens would not produce the desired optical pattern that is the principle of operation of the Strobel reflector/lens system, as the Bertling lens would not have a focal point, as is necessary for the operation of Strobel's system, being a "headlight that illuminates a surface to be illuminated with a desired light distribution by optimal utilization of the light source of the headlight." See Strobel, col. 2, lines 13-17. Replacing Strobel's lens with Bertling's would not result in the light distribution pattern required for the headlamp. Instead, such a proposed modification of Strobel would clearly require a complete redesign of Strobel's reflector surface. As such, the proposed combination would render Strobel unsatisfactory for its intended purpose. See MPEP 2143.02.

For at least these reasons, applicant respectfully submits that one of ordinary skill in the art would not have been motivated to combine the cited references in the manner suggested in the office action, and thus, that claim 1 is patentable over the cited references.

Moreover, the claimed invention yields unexpected and improved results over the prior art. As described in the specification at page 20, line 11 – page 23, line 23, the structure of the claimed lamp device provides a light distribution function that can be given not only to the reflection surface but also the lens, where a more ideal light distribution pattern can be obtained. By forming the lens that has a recess shape, the

light is largely refracted by the lens and the interior section is much less visible (as viewed from an exterior section). As a result, it is not necessary to finish the surface of the reflection surface so as to have the optical performance equal to or more than the optical performance required for reflection, while taking appearance into consideration. Thus, the working operation can be executed in a more straightforward manner in comparison with a conventional lamp device. Further, the recess shape of the lens in the vertical and horizontal cross sections permits the construction of a head lamp in which the light generation area is small and the light quantity is large. For at least these additional reasons, applicant respectfully submits that claim 1 is patentable over the cited references.

As the claimed combination does not render independent claim 1 unpatentable, claims 2-8 are also patentable for at least these reasons.

Regarding claim 2, neither Bertling nor Strobel teach or suggest "the reflection surface of said reflector is structured such that the vertical cross section and the horizontal cross section each substantially have a shape that is part of an oval larger than said lens." See e.g., specification, Figs. 1-3. The office action refers to Fig. 1 of Bertling, as allegedly teaching the claimed reflector surface of claim 2. However, this structural feature is not taught or suggested in Bertling, which does *not* show a reflector surface having a shape that is part of an oval *larger* than the lens. In contrast, in the embodiment shown in applicant's Figs. 1 and 2, the reflector surface 4 has a shape that is part of an oval larger than the lens 1. Accordingly, applicant respectfully submits that claim 2 is patentable over the cited combination for at least this additional reason.

Regarding claims 5-8, applicant respectfully submits that Kusagaya does not overcome the deficiencies of the Strobel/Bertling combination. First, Kusagaya shows a lens 28 that is a flat convex lens having a convex front surface and a flat rear surface, functioning as a condenser lens that allows the light to concentrate on one point. This lens 28 is similar in structure to the lens 2 of Strobel, which is allegedly being replaced by the lens 24 of Bertling. Accordingly, there is no evidence that one of ordinary skill in the art would have first replaced Strobel's lens with Bertling's lens, then modified Bertling's lens to match the shape of Kusagaya/Strobel. Second, applicant respectfully

disagrees that Kusagaya teaches a torus lens. As is shown, in the attached Japanese Optics textbook ("The Complete Optical Instruments," annotated in relevant portions), a torus or toric lens has a horizontal radius of curvature (r2) different from a vertical radius of curvature (r1). There is no description in Kusagaya that teaches or suggests this structure. Accordingly, applicant respectfully submits that claims 5-8 are patentable for at least these additional reasons.

New Claims 9-15

Applicant respectfully submits that new claims 9-13 are patentable over the cited references for at least the same reasons as stated above for claims 5-8. In addition, none of the cited references teach or suggest a lens having a front and back surface having torus or free curve shape.

Regarding claim 13, the cited references do not teach or suggest the claimed structure of a lens having a first recess shape on the front surface and a second recess shape on the back surface.

Regarding claims 14-15, the cited references do not teach or suggest the claimed structure of a lens a first surface having the recess shape and a second surface having a convex shape.

Thus, for at least the reasons mentioned above, applicant respectfully submits the pending claims are allowable.

Conclusion

If applicant has not accounted for any fees required by this Amendment, the Commissioner is hereby authorized to charge to our Deposit Account No. 19-0741. If applicant has not accounted for a required extension of time under 37 C.F.R. § 1.136, that extension is requested and the corresponding fee should be charged to our Deposit Account.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Respectfully submitted,

Date February 6, 2003

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Version with Markings to Show Changes Made (Claims)

2. (Amended) The lamp device for a vehicle according to claim 1, wherein the reflection surface of said reflector is structured such that the vertical cross section and the horizontal cross section each substantially have a shape that is part of an oval [are formed in a substantially oval surface] larger than said lens.

5. (Amended) The lamp device for a vehicle according to claim 1, wherein a torus curved surface or a free curved surface is formed on at least one of a front surface and [or/and] a back surface of said lens.

6. (Amended) The lamp device for a vehicle according to claim 2, wherein a torus curved surface or a free curved surface is formed on at least one of a front surface and [or/and] a back surface of said lens.

7. (Amended) The lamp device for a vehicle according to claim 3, wherein a torus curved surface or a free curved surface is formed on at least one of a front surface and [or/and] a back surface of said lens.

8. (Amended) The lamp device for a vehicle according to claim 4, wherein a torus curved surface or a free curved surface is formed on at least one of a front surface and [or/and] a back surface of said lens.

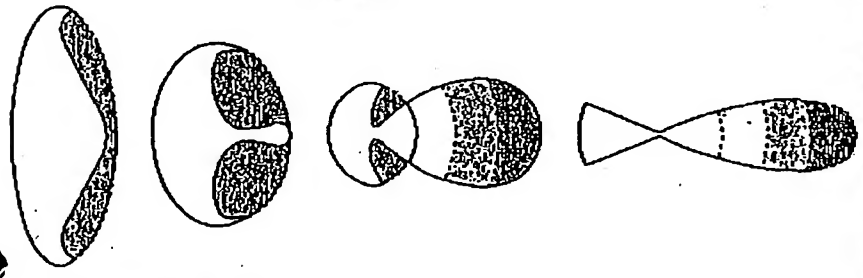

図1-26 収差のある像の実例

直径32mm，焦点距離111mmの平凸レンズに，傾角20°の単色光が入射したときの，実際の写真を図化しました．コンピューター計算ではありません．
上の写真は，A. Gullstrand（眼科光学の開拓者）が，スウェーデンの生理光学の雑誌に，1890年に発表しました．非点収差とコマが混合しています．

ないのです．ひとつの物点が，ボケた像点になるのです．

1−24 像面の弯曲とペッツファール条件

光学系に非点収差があると，メリディオナル像線とサジッタル像線が，それぞれメリディオナル像面とサジッタル像面と，2枚の像面を形成することになります．

そこで，光学系のデータ（n, r, d）をいろいろに変更したり，絞りの位置を調整すると，非点隔差をゼロに近づけることができます．すると，ふたつの像面がほとんど一致して，1枚の像面になりますが，それが平面とは限りません．

ふつうは，レンズ側に凹面を向けた，球面に近い像面になります．これは像面の弯曲（ワンキョク，curvature）という収差です．

共通の光軸上に，焦点距離$f_1, f_2, \cdots\cdots f_k$，屈折率$n_1, n_2, \cdots\cdots n_k$というk枚のレンズがあるとき，像面の曲率半径Rは，次の式で近似されます．

$$\frac{1}{n_1 f_1}+\frac{1}{n_2 f_2}+\cdots+\frac{1}{n_k f_k}=\frac{1}{R} \quad \cdots\cdots (1\cdot64)$$

したがって，平面像の条件は，

$$\frac{1}{n_1 f_1}+\frac{1}{n_2 f_2}+\cdots+\frac{1}{n_k f_k}=\sum_{i=1}^{k}\frac{1}{n_i f_i}=0 \quad \cdots\cdots (1\cdot65)$$

この式をペッツファール（J.Petzval,1807-1891）条件といい，(1・64)式で計算される1/Rはペッツファール曲率といいます．

(1・65)式でわかるように，凸レンズ（fプラス）と凹レンズ（fマイナス）を組み合わ

せないと，平面像は得られません．

像面の歪曲は，理想像の第2番目の条件（物平面と像平面の対応）が満たされないのです．

1−25 トーリック面レンズ

乱視（astigmatism，英語では非点収差と同じ）というのは，非点収差のある眼です．その多くは，角膜表面が球面でないのです．角膜の成る断面（第1主断面）では曲率半径最小，それに直角な断面（第2主断面）では曲率半径最大になっています．

乱視を補正するには，縦方向と横方向とで曲率半径が異なる，トーリック（torus, toric）面レンズを用います．

図1-27は，タイヤの表面の形をした，タイヤ形トーリック面です．垂直面内では曲率半径n，水平面内では曲率半径mです．これは凸レンズとしても，凹レンズとしても用いられます．

A torus or toric lens has a horizontal radius of curvature different from a vertical radius of curvature.

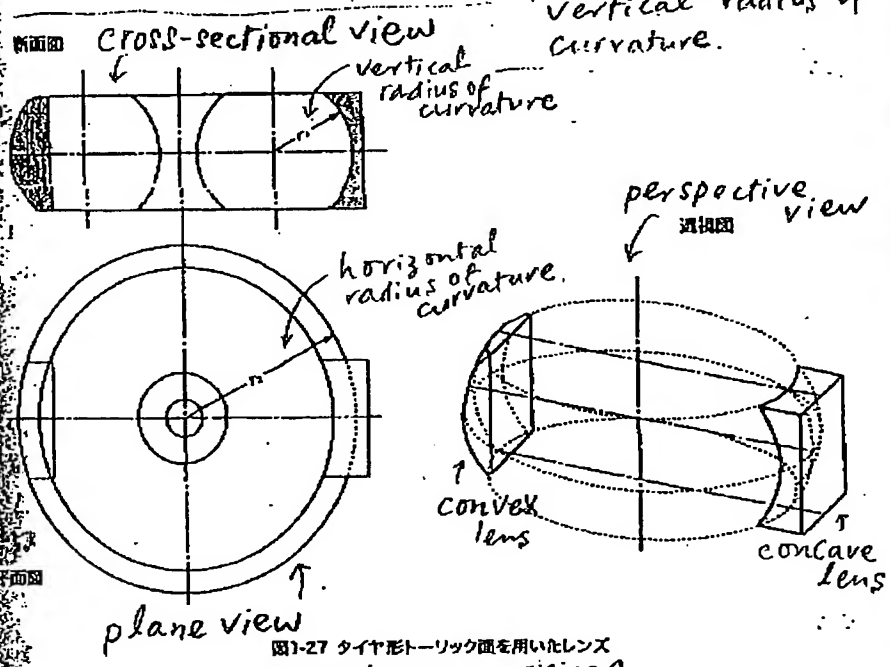

図1-27 タイヤ形トーリック面を用いたレンズ

Fig.A: Lens comprising a tire-shaped toric surface

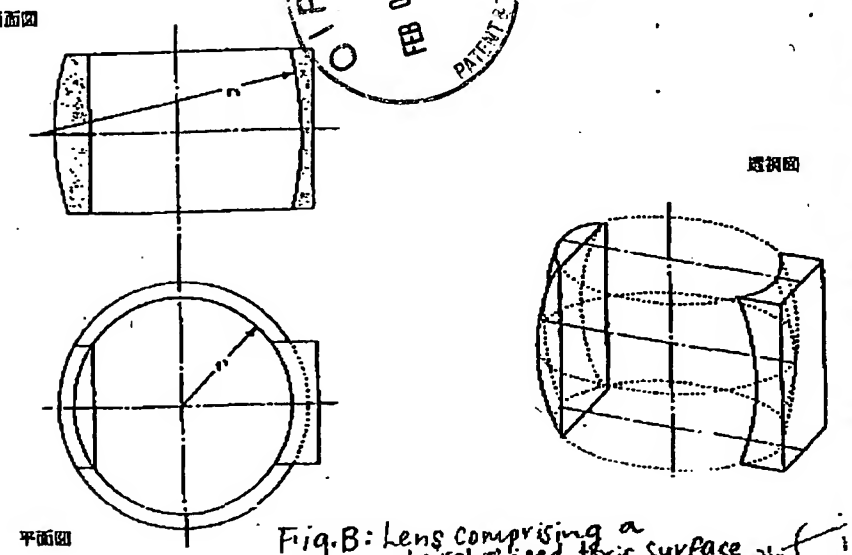

図1-28 樽形トーリック面を用いたレンズ

図1-28は，ビール樽の表面と同じ，樽形トーリック面です．垂直面内では曲率半径r_1，水平面内では曲率半径r_2です．これも，凸レンズにも，凹レンズにも応用されています．

円を，ひとつの直径を軸として回転させると，球面になります．円を，ひとつの弦を軸として回転させれば，トーリック面です．数学では，2次曲線を，その平面上にある1本の直線を軸として回転させるときにできる曲面を，一般にトーラス(torus，円環体，楕円環体)といいます．

1−26 像の歪曲

光学系のデータ(n, r, d)をいろいろに変更して，球面収差，コマ，非点収差，像面の弯曲を，みな実用的に満足できる程度にまで減らしても，なおかつ，物体とその像が相似形かどうかは，まだわかりません．

この収差を像の歪曲(ワイキョク，distortion)といい，これは要するに，理想像の第3条件(物体と像の相似)が満たされないのです．言い換えると，横倍率βが，主光線の傾角によって変わるのです．

図1-29は正しい方眼，図1-30は糸巻型歪曲，図1-31は樽型歪曲です．

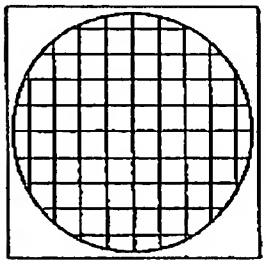

図1-29 正しい方眼

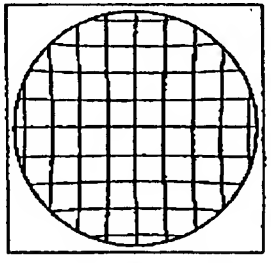

図1-30 糸巻型歪曲

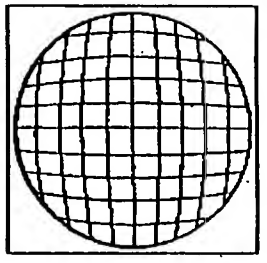

図1-31 樽型歪曲

対角線の伸縮を考えればわかるように，糸巻型歪曲では外側ほど横倍率βが大きいので，これをプラスの歪曲と定義します．

樽型歪曲は，外側ほどβが小さいので，これはマイナスの歪曲とします．

中央に絞りのある対称型レンズで，等倍結像($\beta=-1$)のときは，歪曲は[illegible]です．物界の光線と像界の光線が，完全に対称になるからです．

1−27 3次収差と5次収差

光学系における，光線の屈折や反射のいろいろな角度，たとえば図1-6の入射角i，屈折角i'，ヴァージェンス・アングルu, u'などを，みんなθという文字で代表させることにしましょう．

第1章§5に記したように，$\sin\theta$はθのベキ級数(power series)として展開できますが，このとき，$\sin\theta=\theta$の範囲は近軸光線で，これは理想像を結び，収差はありません．

次に，

$$\sin\theta=\theta-\frac{\theta^3}{6} \quad \cdots\cdots (1\cdot66)$$

の範囲の光線は，ザイデル領域といいます．これは，球面収差，コマ，非点収差，像面の弯曲，像の歪曲という「ザイデルの5収差」を発生します．

近軸光線による結像を深く研究したのは，数学者のガウス(K.F.Gauss,1777-1855)でしたから，近軸光線の理論をガウス光学ともいいます．ガウスは小惑星1番セレス，2番パラスをはじめ，多くの小惑星の軌道を決定し，天文学や測地学にも業績が多く，ゲッチンゲン大学天文台長でもありました．

一方，ルードヴィッヒ・フォン・ザイデル(L.von Seidel,1821-1896)は1856年に，初めてアストロノミッシェ・ナハリヒテン(Astronomische Nachrichten,通称A.N.)Nr.1027-